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A suggestion for a good anode material synthesized and characterized

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The porous nature of a hard carbon material has been synthesized using one of the familiar methods of nanotechnology. Those materials were taken from renewable material of fruit peels, especially, banana peels-*Musa Balbisiana.* This material will be activated to get good intercalation between anode and cathode. This was studied with the help of X-ray diffraction pattern (XRD). The porous nature of the material has been studied with the help of Scanning Electron Microscope (SEM).

INTRODUCTION

In an electrochemical power source, batteries are the most important host for storing energy in the form of chemicals in a material (Aifantis, K. E., 2010). In this case, through the electrochemical reaction of oxidation and reduction proceeding on the surface of the two electrodes, the chemical energy is directly transformed into electrical energy. Hence, the need of a good electrode is more important in a battery. Currently we are focusing on developing biology based anode materials (Kasahara, K., 2016). So far, there are so many ways, to drive hard carbon for an anode of the battery as shown in the figure 1. From lead acid batteries to the sodium ion batteries, hard carbon is the major anode material for all battery applications (Van Noorden, R., 2014). The porous nature of the hard carbon is used to get good intercalation between anode and cathode electrodes during oxidation and reduction process. Hard carbon always shows the amorphous nature because the particles are randomly arranged in a surface and this is considered as porous nature (Qie, L., 2012). Most of the bio derived hard carbon will not give much capacity during intercalation and may be drawn back due to shuttle effect. Yet, the hard carbon derived from banana peels gives more capacity due to high porous nature among the surface.

RESULTS AND DISCUSSION

XRD Analysis

The diffraction spectrum was analyzed with the help of XPERT-PRO diffraction system. The diffraction angle was started at the position $10.0231°$ and ended at the position $80.9231°$. The scanning type was continuous scan type and its step scan time was $10.1600\ s$; step size was $0.0500°$. The source - anode material $(cu - K\alpha\ \&\ \beta)$ had the intensity 1.54060 Å $(K\alpha_1)$, 1.54443 Å $(K\alpha_2)$, 1.39225Å $(K\beta_1)$. The XRD spectrum showed amorphous nature in terms of broad peaks and this proved the presence of Hard Carbon. Thus, the amorphous nature of the hard carbon was clearly shown from XRD spectrum (Fig.8).

Pos. [°2Th.]	Height [cts]	FWHM Left [°2Th.]	d-spacing [Å]	Rel. Int. [%]
10.3336	27.61	0.7200	8.55358	100.00

SEM Analysis

The scanning electron microscope showed the surface morphology of the hard carbon. From the figure 9, the morphology structure was analyzed between $1\mu m\ upto\ 2\mu m$ with working distance of $10.50mm$. The EHT operation was done at $10.00\ KV$. The magnificent range of SEM varied at 10.14 KX, 12.48 KX, 30.52 KX, 31.82 KX, and 36.05 KX. The morphology of the hard carbon always showed the porous nature of the particles. The one of the particles was identified as Pa_1 at $86.92nm$. The porous nature was concluded from XRD-amorphous nature of Broad peaks. Thus, the particle size between the $1\mu m\ to\ 2\mu m$ clearly showed the hard carbon nature.

CONCLUSION

The hard carbon from banana peels was successfully synthesized by top down approach (pyrolysis method) of nanotechnology. The X-ray diffraction study confirms the amorphous nature of hard carbon. The porous nature of the morphology was clearly analyzed with the help of scanning electron microscope. Thus, a good anode electrode material has been synthesized for battery applications.

MATERIALS AND METHODS

Material

Banana peels (Kingdom: plantea / Genus: Musa / Botanical Name: *Musa Balbisiana*). Figure 2 shows bananas, the fruits of a plant of the genus *Musa* (family Musaceae), which is cultivated primarily for food and secondarily for the production of fiber used in textile industries, and they are also cultivated for ornamental purposes, but in here we are

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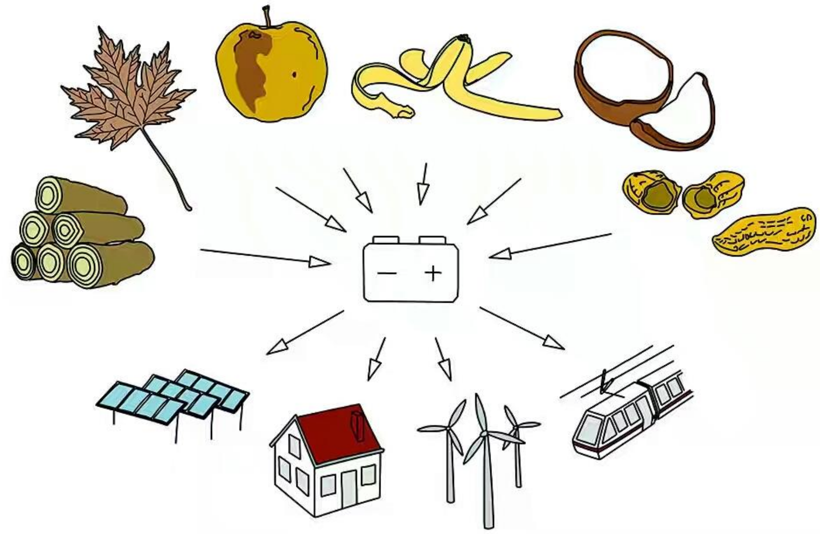

Figure 1 Bio- derived hard carbon from various materials

Figure 2 *Musa Balbisiana*

Figure 3 *Musa Balbisiana* peels were subjected to dry

Figure 4 Dried *Musa Balbisiana* peels after three days

Figure 5 Small pieces of *Musa Balbisiana* at 110℃

Figure 6 *Musa Balbisiana* peels converted into carbon at 250℃

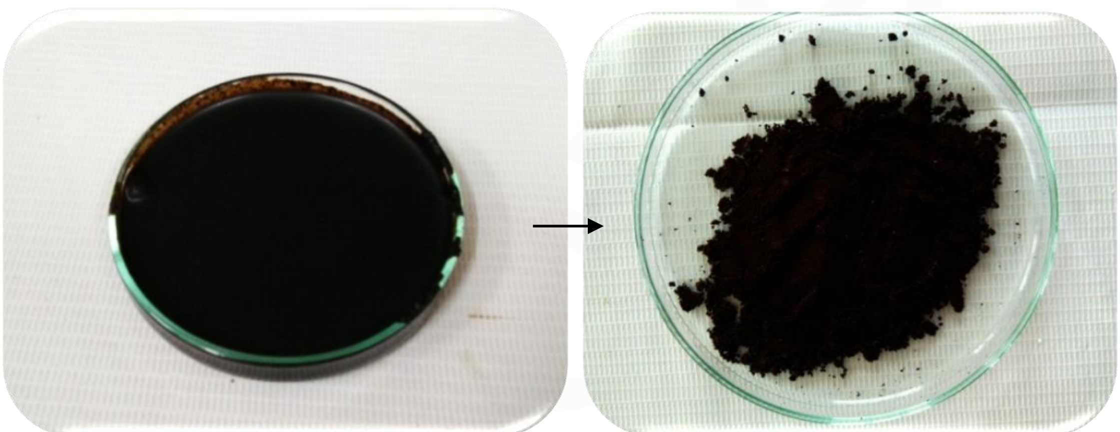

Figure 7 Carbon black charcoal and dried activated carbon powder

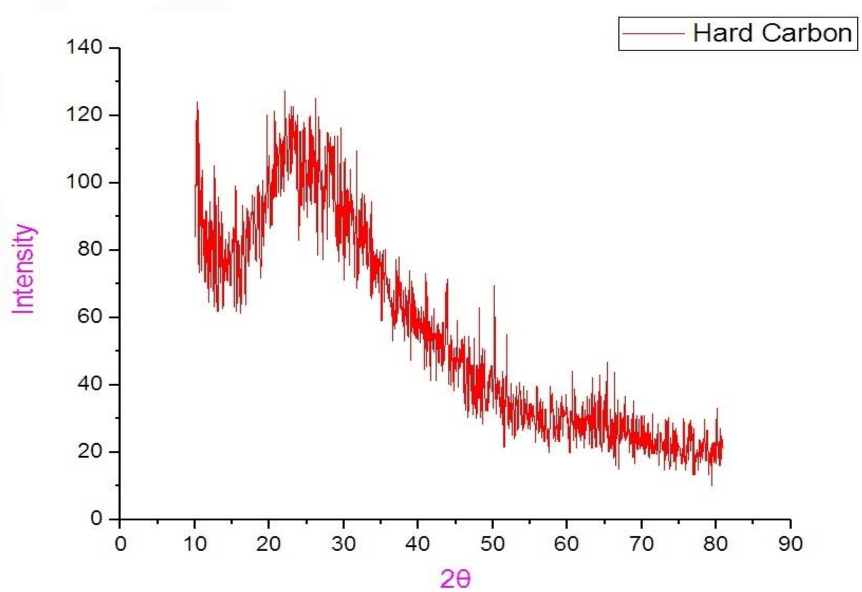

Figure 8 XRD spectrum of Hard Carbon

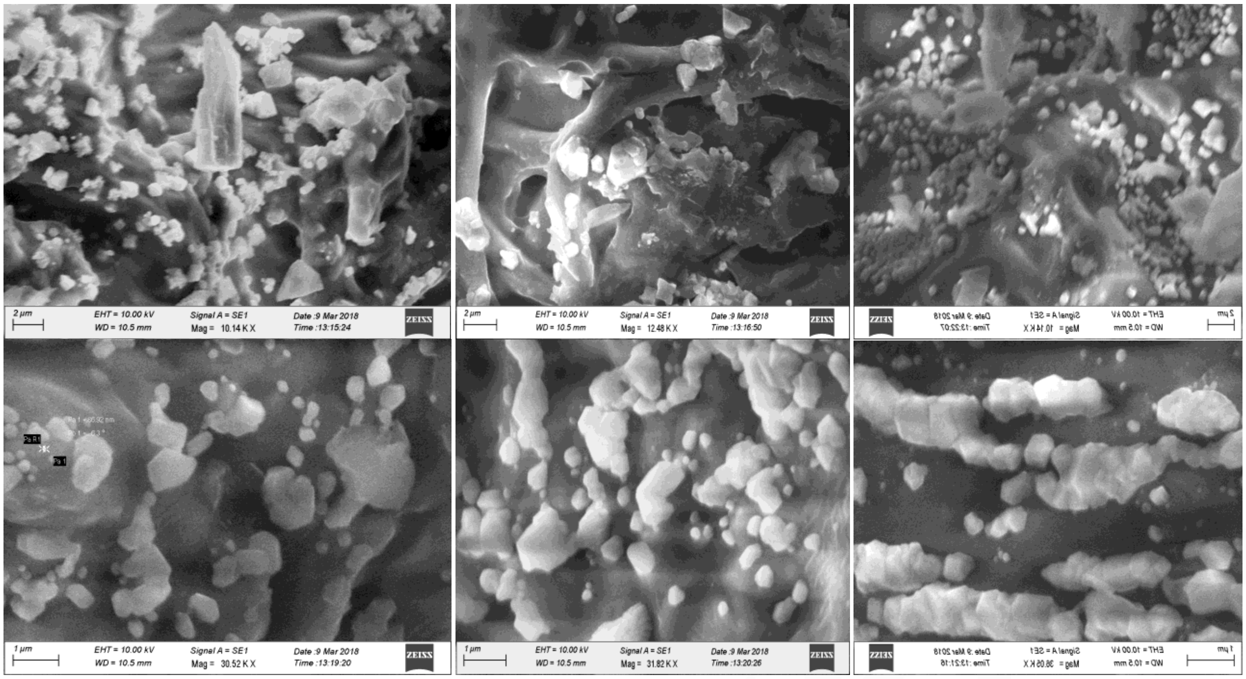

Figure 9 SEM analysis of Hard Carbon

trying to synthesis hard carbon for battery applications (Harrison S.G.,1969).

Method

Few "*Musa Balbisiana"* peels had been taken and they were subjected to the pyrolysis method of nanotechnology (Park, S., 2009). Figures 3 & 4 shows the banana peels and the peels which were dried for three days. The dried banana peels were cut into small pieces as shown in the figure 5. Then, the sample (Banana peels pieces) was placed in muffle furnace for 18 hours at 110℃ temperature. After that, the sample underwent graining process which made the sample in a nanoscale. Then, it was cleaned with the help of 20% of ethanol and again it was subjected to heating process. Now the sample was kept at vacuum oven for 20 hours at 250℃ temperature. The collected sample was again subjected to graining process. Figure 6 shows the collected sample of hard carbon. For application process, the sample was treated with 10% of KOH and 15% of HCL for activation process (Mattson, J. S, 1971). Figure 7 shows the treated sample of carbon black charcoal. Then, this charcoal was again subjected to heating process, and it was placed at the vacuum oven for 24 hours at 110℃ temperature. Then, the sample was grained into nanoscale and characterized using XRD and SEM analysis for concluding the nature of the synthesized sample.

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